



Workshop BIOEN/PPP Etanol on Sugarcane Photosynthesis

**Projeto Diretrizes de Políticas Públicas
para a Agroindústria Canavieira do
Estado de São Paulo**

Fapesp, February 18th, 2009



DIRETRIZES DE POLÍTICAS PÚBLICAS
PARA A AGROINDÚSTRIA CANAVIEIRA
DO ESTADO DE SÃO PAULO



Workshops

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> Novidades e eventos

26/09/2007

CONFERÊNCIA NACIONAL DE BIOENERGIA - USP -
UNIVERSIDADE DE SÃO PAULO OBJETIVOS DA
BIOCONFERÊNCIA ...

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25/09/2007

SIMPÓSIO DE AGROENERGIA E
BIOCOMBUSTÍVEL: "Oportunidades para Um Novo
Modelo Energético" Período: ...

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20/09/2007

XX SEMANA DA AGRONOMIA - CANA-DE-AÇÚCAR
O Centro Acadêmico da Agronomia e a UNESP Iha
Solteira p...

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> Newsletter

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Bem vindo ao nosso Web Site

Este projeto tem por objetivo propor diretrizes,
estratégias e políticas para o desenvolvimento
do setor sucroalcooleiro no Estado de São
Paulo. Para tal está sendo realizado um
projeto de pesquisa integrado, a partir da
cooperação de uma equipe interdisciplinar de
pesquisadores com vasta experiência
acadêmica e profissionais do setor.

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> Workshops

- [VII Workshop - Pragas da
Cana-de-Açúcar](#)
- [VI Workshop - Produção Vegetal e
Modelagem Agrícola](#)
- [V Workshop - Melhoramento Genético
e Biotecnologia](#)

OUTROS ARQUIVOS

- Cronograma 2007 
- Metodologia Workshop 
- Projeto PPP 

> Parceiros

Apoio Financeiro

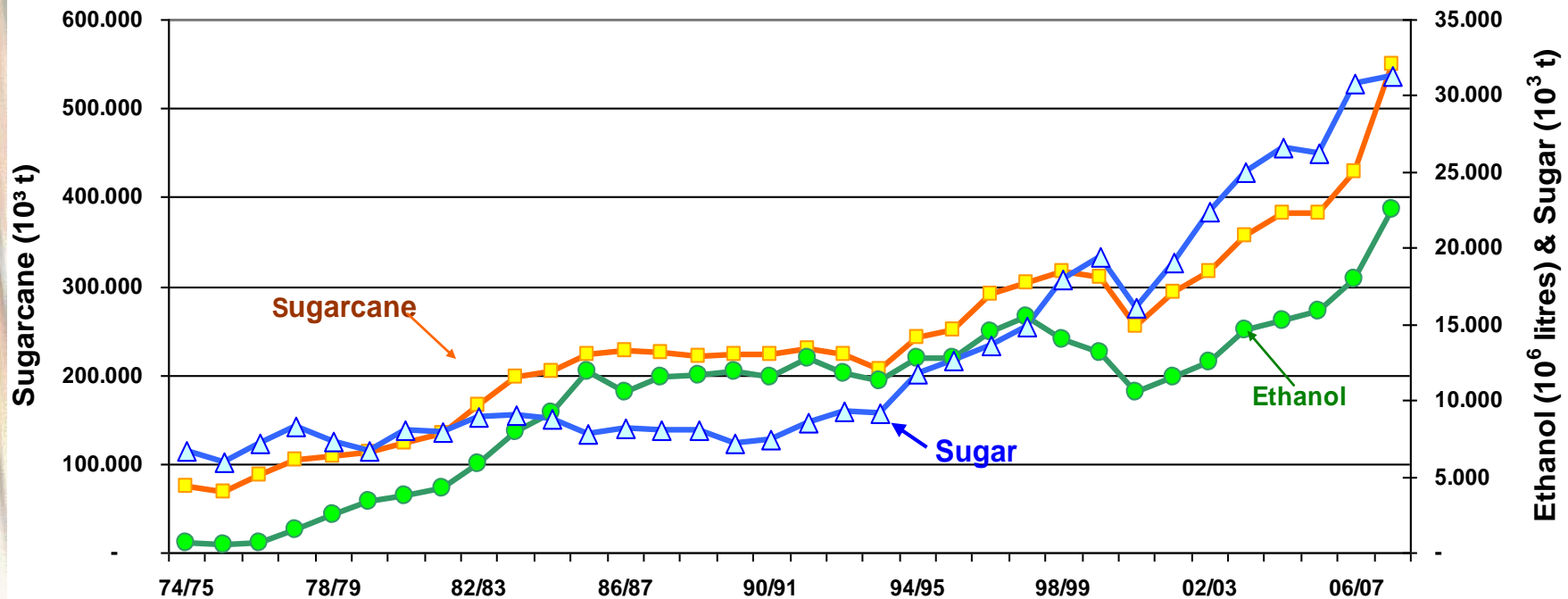


Parceiros

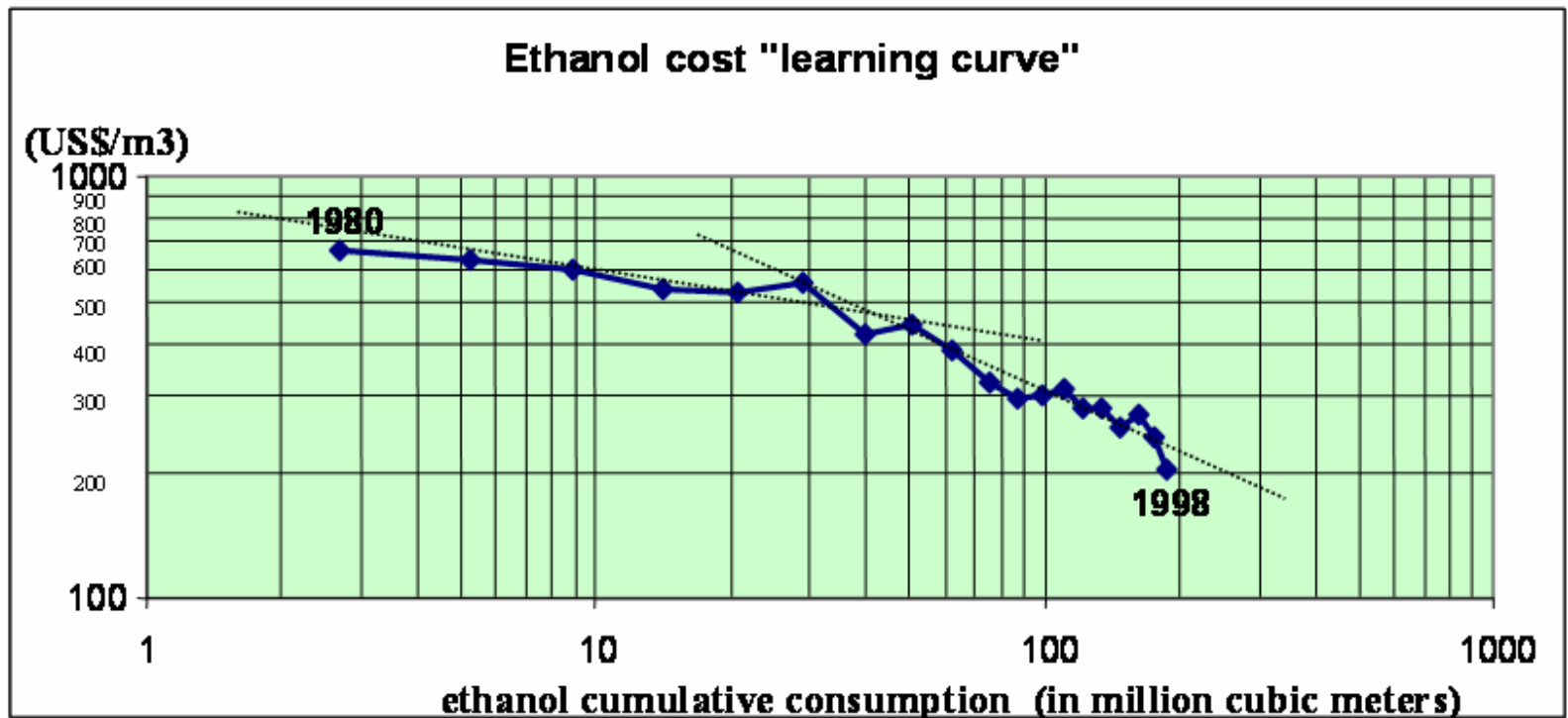


Brazilian Production

Evolution of Production: sugarcane, sugar and ethanol




Learning Curve – Brazilian Ethanol

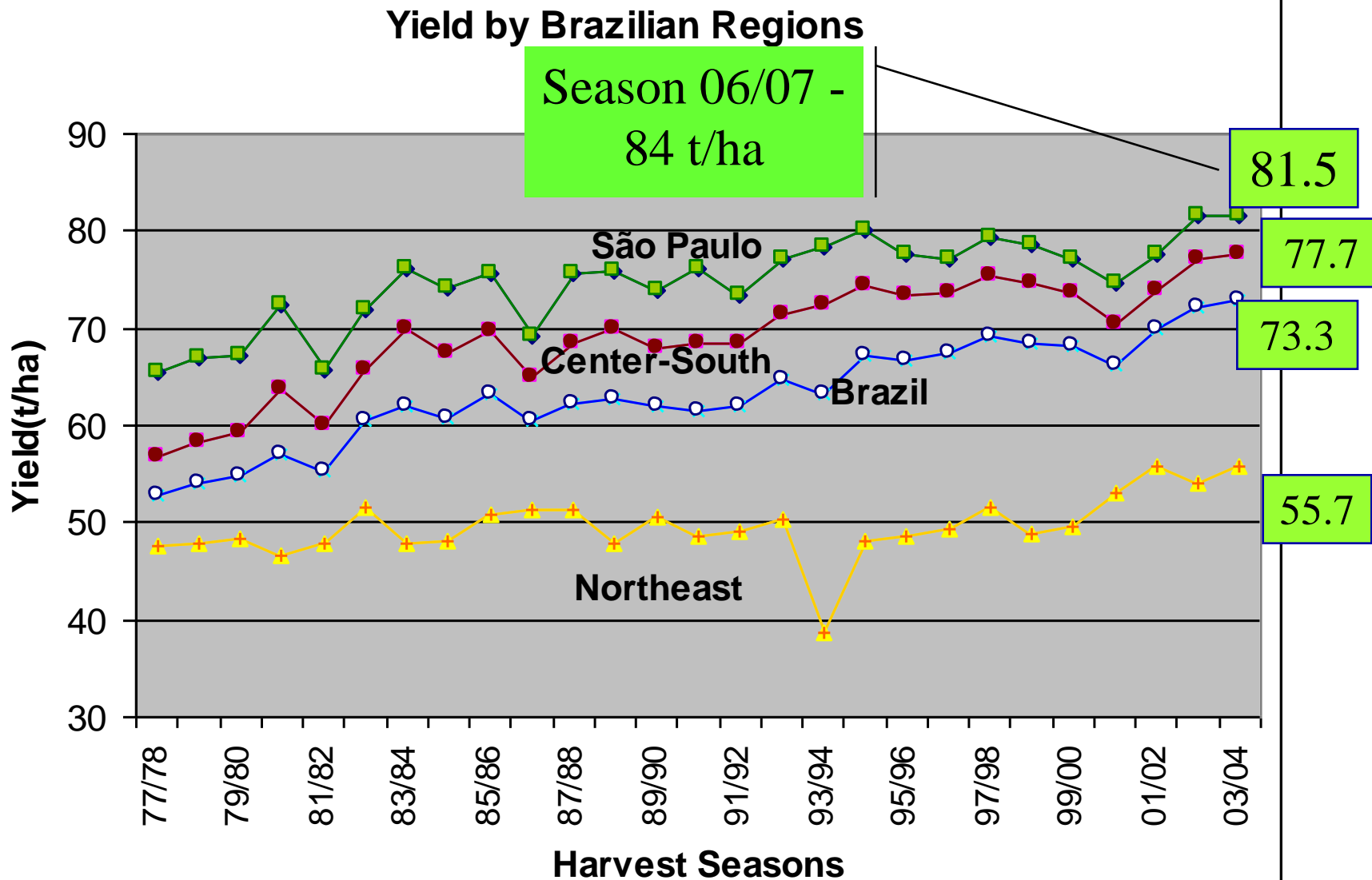


Goldemberg, J.

Brazilian Ethanol: reasons for success

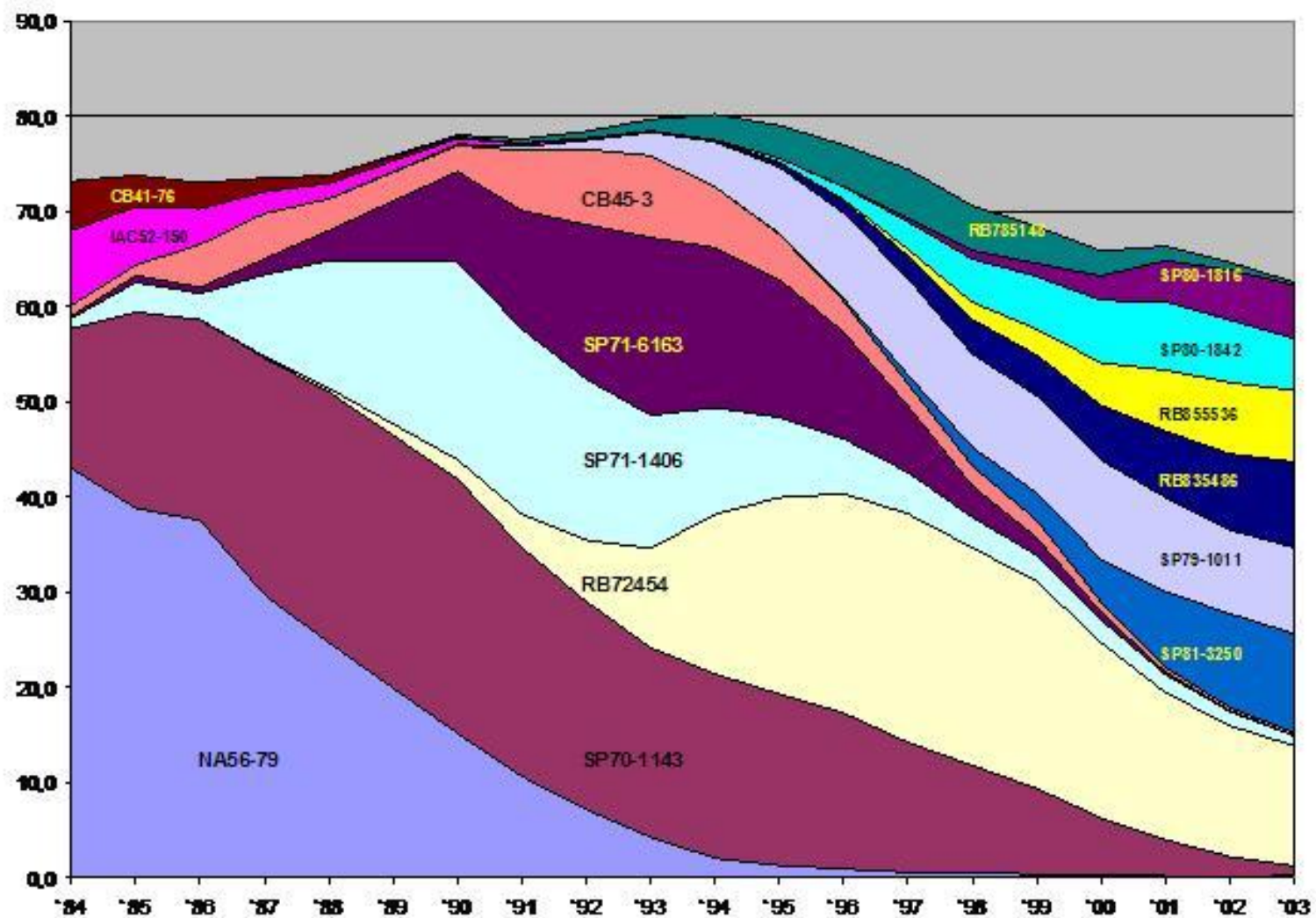
- 
- ✓ Brazil established a dynamic relation between Research and Production since the 30'ies
 - ✓ Sugarcane, an excellent energy crop
 - ✓ Creation of the “Brazilian Model” combining efficient sugar and ethanol production

Productivity (t/ha)



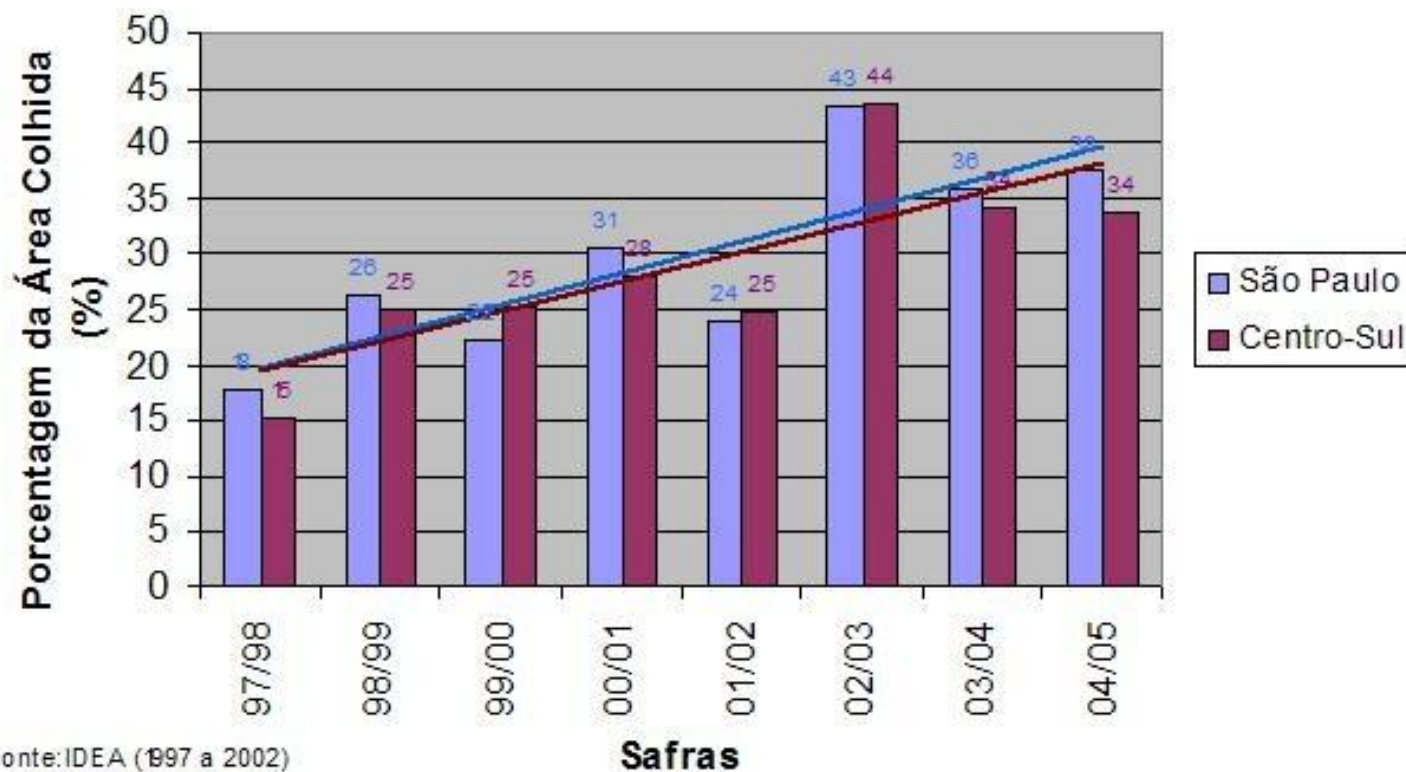
A Agroindústria de Cana-de-Açúcar Brasileira

Variety concentration is less than that observed 20 years ago.



A Agroindústria de Cana-de-Açúcar Brasileira

Evolução da Colheita Mecânica



Fonte: IDEIA (1997 a 2002)
CTC (2003 a 2004)

BIOFUEL PRODUCTION COSTS

Biofuel/Feedstock	US\$/L gasoline or diesel eq.
Ethanol	
Sugarcane	0.25 – 0.50
Maize	0.50 – 0.80
Sugar beet	0.63 – 0.83
Wheat	0.70 – 0.95
Lignocellulose	0.80- 1.10
Biodiesel	
Animal fat	0.40 – 0.55
Vegetable oil	0.70 – 1.00
Lignocellulose (FT)	0.90 – 1.10
Gasoline/Diesel¹	0.16 – 0.50

Doornbosch and Steenblink, 2007

Note: 1. Oil price US\$ 20 – 70/barrel

ETHANOL AND BIODIESEL GHG REDUCTION

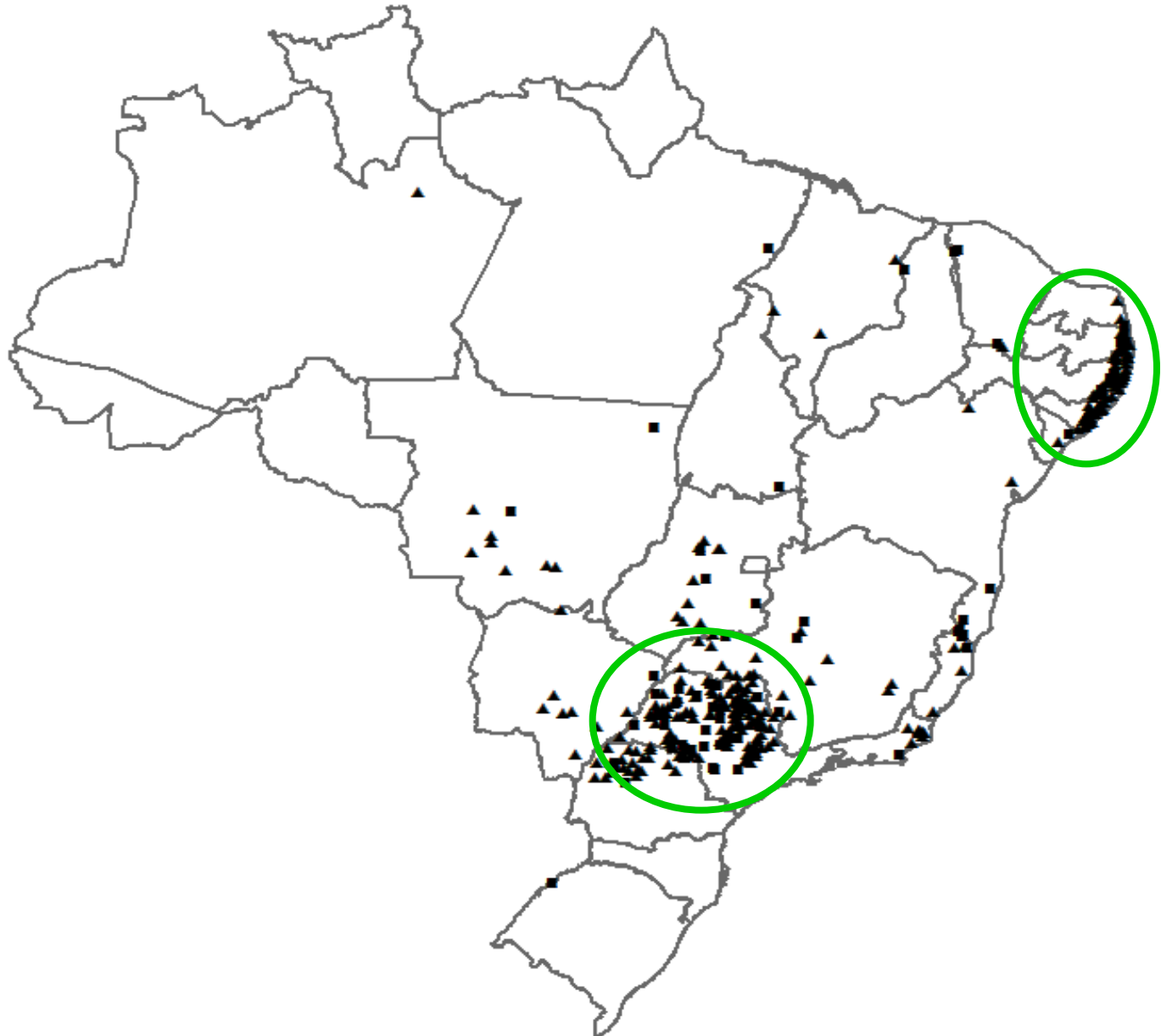
Biofuel/Crop	GHG Emission Reduction
Ethanol¹	
Sugarcane	90 %
Lignocellulose	70 - 90 %
Sugar beet	40 - 50 %
Maize	13 %
Biodiesel²	
Rapeseed/soybeans	40 - 50 %
Palm oil	35 %

ENERGY BALANCE IN ETHANOL PRODUCTION

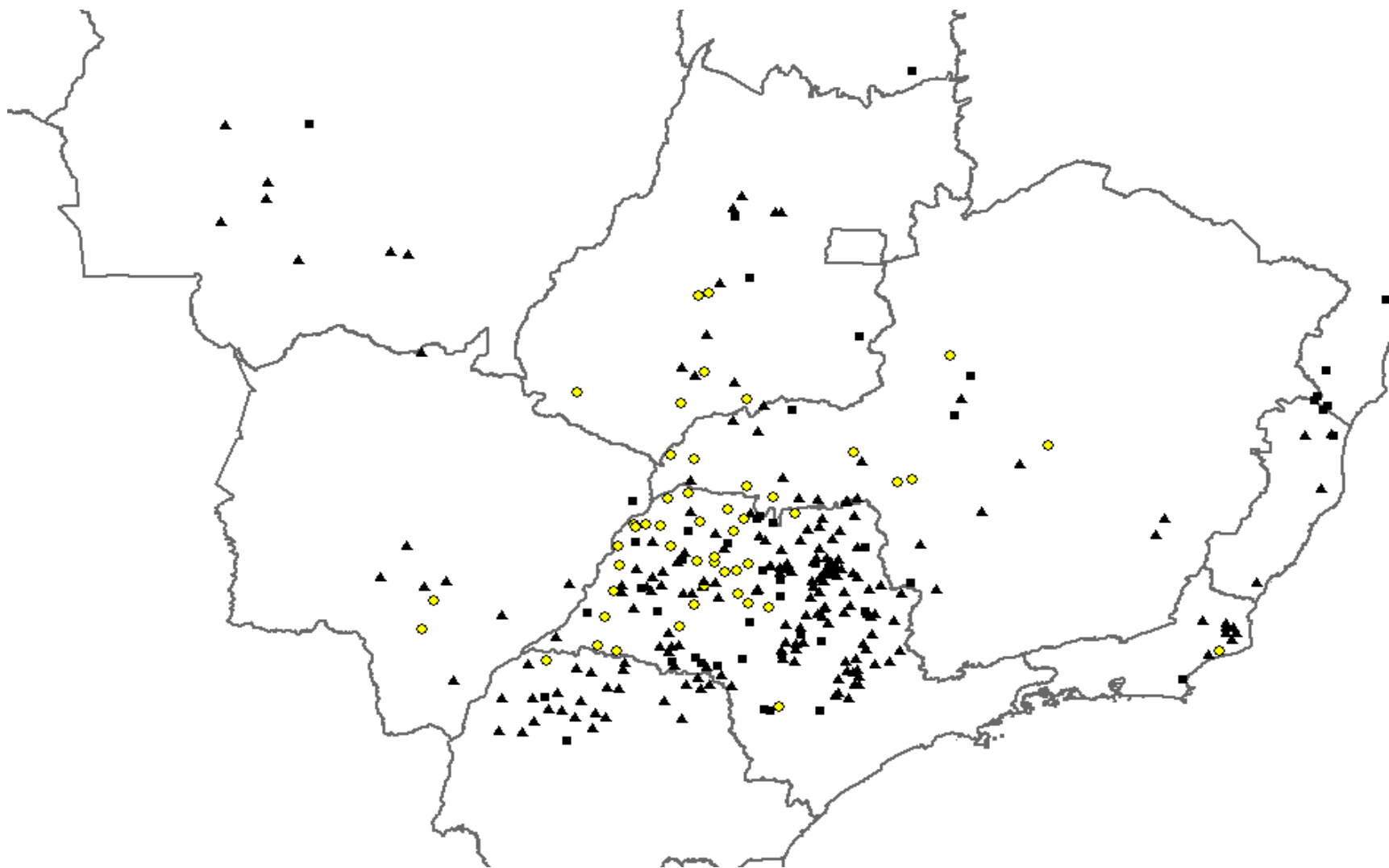
PROCESS	Maize ¹	Switchgrass ₁	Cane ²
	(GJ/ha.yr)	(GJ/ha.yr)	(GJ/ha.yr)
Energy consumption in agriculture	18.9	17.8	13.9
Biomass energy	149.5 ³	220.2	297.1 ⁴
Energy ratio in agriculture	7.9	12.3	21.3
Energy consumption in distillery	47.9	10.2	3.4
Ethanol energy content	67.1 ⁵	104.4	132.5 ⁶
Total energy ratio	1.21	4.43	8.32

Notes: 1-Source: ORNL, 2- Source: Copersucar/UNICAMP, 3- Corn Stover not included, 4- Tops and leaves not included, 5- Does not include credit for co-products, 6- Includes credit for 8% bagasse surplus

Present Location of Sugar-Ethanol Mills in Brazil



Near Term Expansion of New Sugar-Ethanol Mills (●), C-S



Brazil: main crops 2007

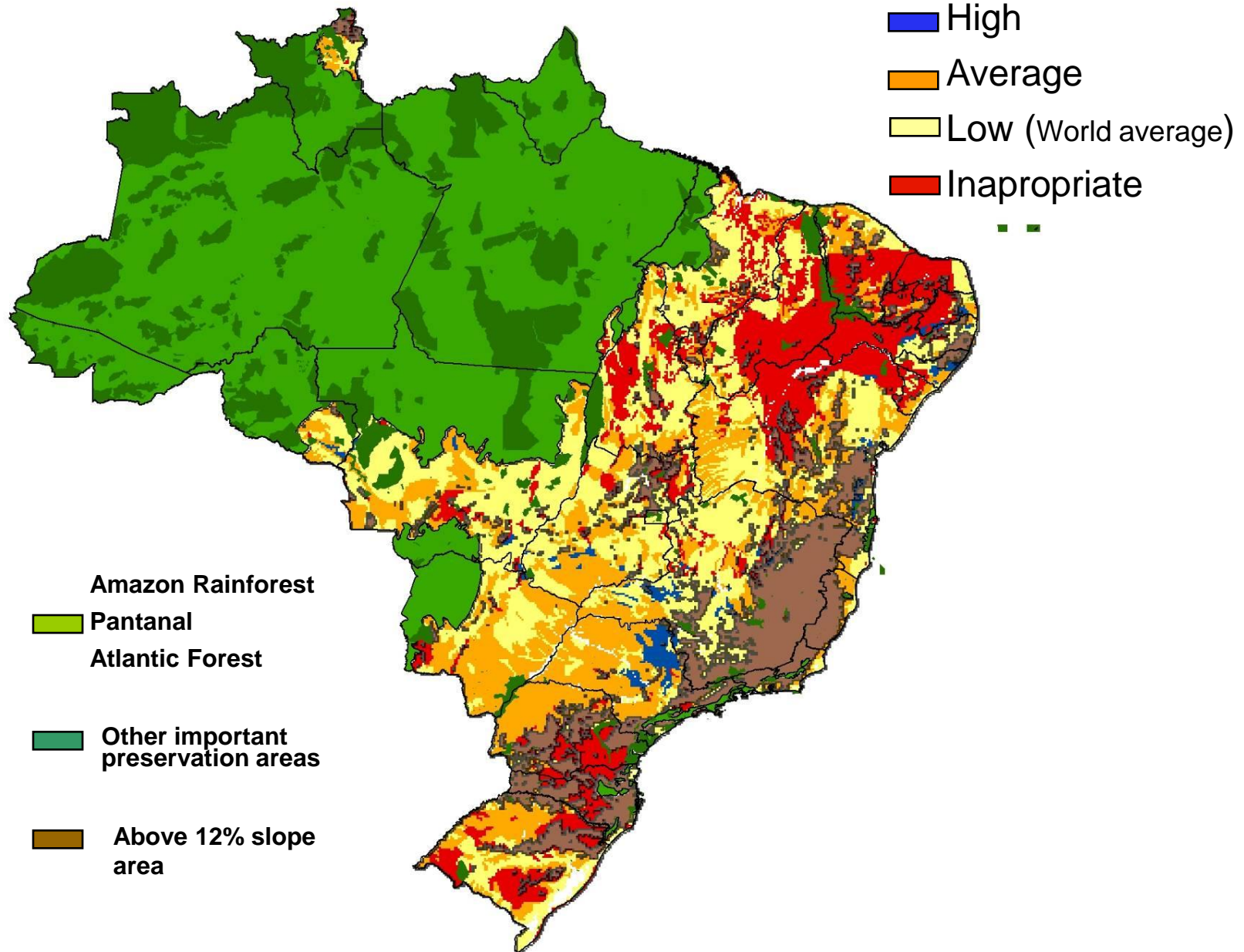
Brazil: 851 10⁶ ha

Total Arable land: 350 10⁶ ha

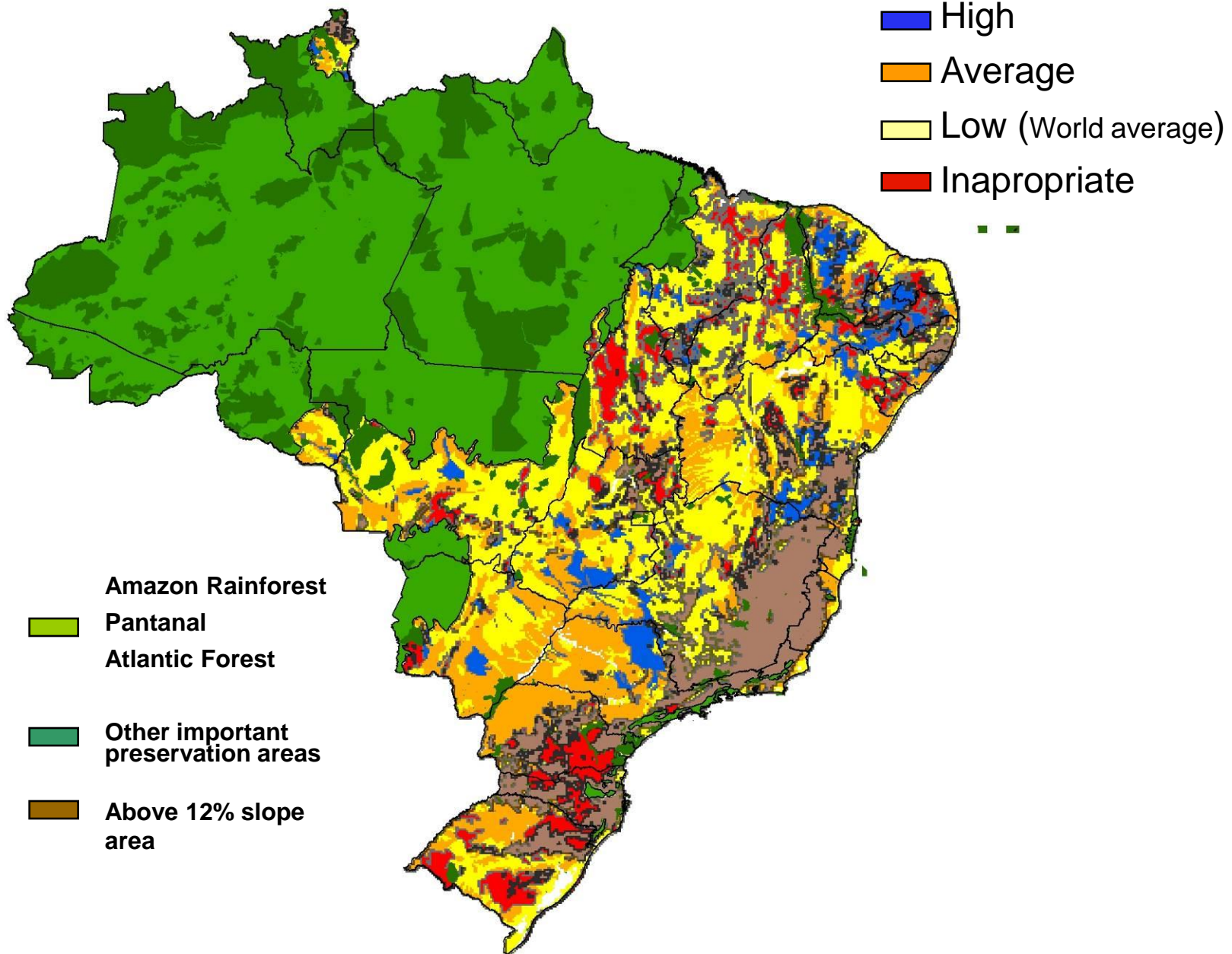


	Area [10 ⁶ ha]
Pasture	150-200
Soybean	22
Corn	11
Sugarcane	7
Others	21
Agric. land	61

POTENTIAL FOR SUGAR CANE PRODUCTION: SOIL AND CLIMATE - WITHOUT IRRIGATION



POTENTIAL FOR SUGAR CANE PRODUCTION: SOIL AND CLIMATE – WITH IRRIGATION



Ethanol Production Cost

	R\$/m ³	(%)
✓ Raw Material (cane)	390	68.5
✓ Industrial Cost	133	23.3
✓ Management Cost	47	8.2
✓ Total	570	100.0

Expected Productivity Gains

	2005	2015	2025
Cane Prod. (t/ha.year)	70	82	96
Pol (%) cane	14.5	15.9	17.3
Industrial efficiency (%)	83.5	90.0	90.0
Liters ethanol/ha	6,000	8,200	10,400

Impact of New Technologies

	2005		2015		2025	
Technology	l/tc	l/ha	l/tc	l/ha	l/tc	l/ha
Conventional	85	6,000	100	8,200	109	10,400
Hydrolysis	---	----	14	1,100	37	3,500
Total	85	6,000	114	9,300	146	13,900

area needed for 104 M l

17 M ha

7.5 M ha

Sugarcane Primary Energy

	Sugarcane	Energy Cane
Produtivity (t/ha.year)	70	100
Fiber (%) cane	13.5	26.0
Trash (%) cane	140	25.0
Pol (%) cane	14.5	12.0
Total fiber (t/ha.year)	19.3	51.0
Primary Energy (GJ/ha.year)	520 (12.5 toe)	1.100 (26 toe)

Questions:

- ✓ What are the limits for traditional sugarcane breeding ?
- ✓ What is sugarcane productivity potential?
- ✓ Is sugarcane productivity close to its potential?
- ✓ Natural selection really optimizes or there is a way to make it better?
- ✓ Is “energy cane” possible?
- ✓ What is the current status of photosynthesis in the world today?
- ✓ What are the most important bottlenecks?